REMARKS

In the Office Action, the Examiner rejected claims 1-5, 7, 9-18, 20, 22-31, 33, 35, 37-49. By the present Response, claim 42 is canceled without prejudice, and new claim 50 is added. The subject matter of new claim 50 does not add any new matter. Upon the cancellation of claim 42 and entry of claim 50, claims 1-5, 7, 9-18, 20, 22-31, 33, 35, 37-41, and 43-50 will be pending in the present patent application. Applicants respectfully request reconsideration and allowance of all pending claims in view of the foregoing amendments and following remarks.

Preliminary Remarks

As a preliminary matter, Applicants would like to bring several issues to the Examiner's attention. First, Applicants note that in the previous Office Action mailed on January 29, 2008, the Examiner rejected <u>all</u> of the pending claims based upon Hossack et al., U.S. Patent No. 6,014,473 (hereinafter the "Hossack reference"). In the Response filed on April 29, 2008 (hereinafter the "Previous Response"), Applicants pointed out a number of deficiencies of the Hossack reference. In particular, Applicants noted in the Previous Response that the Hossack reference is deficient with regard to at least the following recited features (among others):

1. The acquisition of one-dimensional motion data for an organ acquired along respective first, second, and third perpendicular axes (recited by claims 1, 14, 27, and 38).

2. The derivation of motion vectors for each of the first, second, and third sets of one-dimensional motion data (recited by claims 1, 14, 27, and 38).

3. Validating the acquired one-dimensional motion data using one or more sets of validation motion data (recited by claims 3, 16, 28, and 41).

4. Acquiring one-dimensional motion data using one or more sensors affixed to a subject of interest (recited by claims 44, and 46).

See, generally, Previous Response, pages 18-28.

As will be discussed in further detail below, while the Examiner appears to have cited additional secondary references in the present Office Action, presumably to remedy the previously noted deficiencies of the Hossack reference, Applicants still do not believe that the combination of the Hossack reference and the newly cited secondary references teach <u>each and every element</u> recited by each of the presently pending claims to support the Examiner's newly formed grounds of rejection under Section 103.

Second, Applicants note that the Examiner stated in the Office Action that claims 1-5, 7, 9-18, 20, 22-31, 33, 35, 37-43, 45, 47, and 49 were rejected under Section 103 based upon the combination of the Hossack reference in view of Friemel et al., U.S. Patent 5,899,861 (hereinafter the "Friemel reference"). *See* Office Action, page 2. This rejection is unclear and ambiguous. Particularly, Applicants stress that in the Examiner's remarks regarding the rejection of the claims 1-5, 7, 9-18, 20, 22-31, 33, 35, 37-43, 45, 47, and 49, the Examiner <u>never</u> once alludes to the Friemel reference, but instead discusses the Hossack reference in combination with the printed publication entitled "*Three Dimensional Ultrasound Imaging Using Multiple Magnetic Tracking Systems and Miniature Magnetic Sensors*," by Leotta et al. (hereinafter the "Leotta reference"). *See id.* at page 3.

Thus, in view of the ambiguity regarding the present rejection of claims 1-5, 7, 9-18, 20, 22-31, 33, 35, 37-43, 45, 47, and 49, Applicants have responded to the Office Action under the assumption that the Examiner *intended* to state that claims 1-5, 7, 9-18, 20, 22-31, 33, 35, 37-43, 45, 47, and 49 are rejected based upon the combination of the <u>Hossack and Leotta references</u>, rather than the <u>Hossack and Friemel</u> references.

However, if this assumption is incorrect, Applicants respectfully request that the Examiner provide additional clarification in a subsequent non-final Office Action, such that Applicants are given a fair opportunity to respond to the present rejection.

Rejections Under 35 U.S.C. §103

The Examiner rejected claims 1-5, 7, 9-18, 20, 22-31, 33, 35, 37-43, 45, 47, and 49 as being unpatentable over the Hossack reference in view of the Leotta reference, as discussed above in the "Preliminary Remarks" section. The Examiner further rejected claims 44, 46, and 48 as being unpatentable over the Hossack reference in view of the Leotta reference, and further in view of the Friemel reference. Applicants respectfully traverse the rejections.

Legal Precedent

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (PTO Bd. App. 1979). To establish a *prima facie* case, the Examiner must not only show that the combination includes *all* of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). In addressing obviousness determinations under 35 U.S.C. § 103, the Supreme Court in *KSR International Co. v. Teleflex Inc.*, No. 04-1350 (April 30, 2007), reaffirmed many of its precedents relating to obviousness including its holding in *Graham v. John Deere Co.*, 383 U.S. 1 (1966). In *KSR*, the Court also reaffirmed that "a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *Id.* at 14. In this regard, the *KSR* court stated that "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does ... because inventions in most, if not all, instances rely upon

building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." *Id.* at 14-15.

Furthermore, the *KSR* court did not diminish the requirement for objective evidence of obviousness. *Id.* at 14 ("To facilitate review, this analysis should be made explicit. See *In re Kahn,* 441 F.3d 977, 988 (CA Fed. 2006) ("[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness"). As our precedents make clear, however, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ."); s*ee also, In re Lee,* 61 U.S.P.Q.2d 1430, 1436 (Fed. Cir. 2002) (holding that the factual inquiry whether to combine references must be thorough and searching, and that it must be based on *objective evidence of record*).

Additionally, when prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988). One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

The Hossack and Leotta references fail to teach or suggest several features recited by Independent Claims 1, 14, 27, and 38.

Independent claim 1 recites, *inter alia*, "acquiring a first set of <u>one-dimensional motion data</u> for an organ along a first axis by a first methodology; acquiring a second set of <u>one-dimensional motion data</u> for the organ along a second axis by a second

methodology, wherein the first axis and the second axis are perpendicular; acquiring a third set of one-dimensional motion data for the organ along a third axis by a third methodology, wherein the third axis is perpendicular to the first axis and the second axis; deriving one or more concurrent motion vectors from *each* of the first, second, and third sets of one-dimensional motion data; and combining the one or more concurrent motion vectors to generate a set of three-dimensional motion data for the organ." (Emphasis added). Independent claim 14 recites a computer readable storage medium having executable code stored thereon comprising routines for performing the steps recited by independent claim 1.

Next, independent claim 27 recites an imaging system comprising, *inter alia*, "an imager configured to generate a plurality of signals representative of one or more structures within a region of interest ... a sensor-based motion determination system configured to acquire one-dimensional motion data from one or more sensors ... wherein the imager, the sensor-based motion determination system, or a combination of the imager and the sensor-based motion determination system is configured to acquire a first, a second, and a third set of one-dimensional motion data for an organ along respective first, second, and third perpendicular axes ... and wherein at least one of the sensor-based motion determination system, the data processing circuitry, or the operator workstation are configured to derive one or more concurrent motion vectors from *each* of the first, second, and third sets of one-dimensional motion data and to combine the one or more concurrent motion vectors to generate a set of three-dimensional motion data for the organ." (Emphasis added).

Further, independent claim 38 recites, *inter alia*, "an imager configured to generate a plurality of signals representative of one or more structures within a region of interest and to acquire at least one set of acquisition image data used to derive a first, a second, or a third set of one-dimensional motion data for an organ along respective first, second, and third perpendicular axes ... wherein at least one of the data processing

circuitry or the operator workstation is configured to derive one or more concurrent motion vectors from *each* of the first, second, and third sets of one-dimensional motion data and to combine the one or more concurrent motion vectors to generate a set of three-dimensional motion data for the organ." (Emphasis added).

Thus, to summarize, Applicants note that each of independent claims 1, 14, 27, and 38 recites at least the following three features:

1. The acquisition of three sets of one-dimensional motion data for an organ in different directions (first, second, and third axes);

2. The acquisition of the one-dimensional motion data along three respective axes which are perpendicular with respect to one another; and

3. The derivation of motion vectors for *each* of the first, second, and third sets of one-dimensional motion data.

As discussed in detail below, Applicants, after carefully reviewing the cited references as well as the Examiner's comments in the Office Action, do not believe that the above-listed features are disclosed by the Hossack and Leotta references, either alone or in combination.

1. The cited references fail to teach or suggest the acquisition of three sets of one-dimensional motion data for an organ along three different respective axes.

As discussed in detail in the Previous Response, the Hossack reference fails to disclose the acquisition of one-dimensional motion data for an organ. *See, generally,* Previous Response, pages 20-21. In contrast, the Hossack reference is directed towards a technique for acquiring *two-dimensional* motion data. For example, the "Background" section of the Hossack reference clearly states that the invention "relates to an improved system, method and transducer for acquiring two-dimensional image information and

relative positional information regarding the image information to allow subsequent three-dimensional or extended field of view reconstruction." Hossack, col. 1, lines 14-18. (Emphasis added).

In the Office Action, the Examiner, in maintaining the rejection of independent claims 1, 14, 27, and 38, cited the three transducer arrays 18, 20, and 22 of an ultrasonic transducer device 16 (e.g., shown in Figs. 2-4 of the Hossack reference) as corresponding to the first, second, and third methodologies, respectively, for acquiring one-dimensional motion data, as recited by independent claims 1 and 14. *See* Office Action, page 2 (the Examiner characterizing the transducer arrays 18, 20, 22 as being *two* separate motion-sensitive sensor-based methodologies and *one* imaging methodology).

As an aside, it should be noted that Applicants do not agree with the Examiner's assertion that one of the transducer arrays 18, 20, 22 of Hossack could arbitrarily be classified as an "imaging" methodology while the remaining two arrays are classified as "motion-sensitive sensor-based" methodologies, particularly in light of the fact that the Hossack reference appears to describe each of the transducer arrays 18, 20, and 22 as operating in generally the same manner and acquiring the same type of data. Rather, it appears that the Examiner is employing impermissible hindsight in arbitrarily characterizing the same type of devices, i.e., transducers, as different elements, i.e., an imaging device *and* a motion-sensitive sensor, in order to craft a rejection that reads upon Applicants' claims. However, even assuming for the sake of argument that such an interpretation could be considered reasonable, based on this interpretation, Applicants note that the Examiner has still failed to demonstrate that each of the transducer arrays 18, 20, and 22 acquire *one*-dimensional motion data.

As discussed in the Previous Response, the Hossack reference *clearly* sets forth that each of the transducer arrays 18, 20, and 22 are configured to acquire two-dimensional image frames, which are subsequently aligned during reconstruction to

create a three-dimensional image. *See* Hossack, col. 14, lines 55-61. For instance, with reference to Figs. 2-4, the Hossack reference describes the ultrasound transducer device 16 as including a first transducer array 18 configured to acquire a first set of two-dimensional data (e.g., image plane 58) along an azimuthal axis (A), a second transducer array 20 configured to acquire a second set of two-dimensional data (e.g., image plane 60) along a first tracking axis (T1), and a third transducer array 22 configured to acquire a third set of two-dimensional data (image plane 62) along a second tracking axis (T2). *See id.* at col. 5, lines 48-56; Figs. 2-4. The sets of two-dimensional data are then processed by a "Three-Dimensional Volume Filling Computer 36," as shown in Fig. 1, which translates and interpolates the data acquired by the transducer arrays 18, 20, and 22 to produce a reconstructed three-dimensional image. *See id.* at col. 4, line 58 – col. 5, line 33. Indeed, there does not appear to be any teaching in the Hossack reference to suggest that the transducer arrays 18, 20, and 22 of the ultrasound transducer device 16 are configured to or even capable of acquiring one-dimensional motion data, as recited by independent claims 1, 14, 27, and 38.

In the present Office Action, the Examiner, in responding to Applicants' arguments presented on pages 20-21 of the Previous Response, asserted the following:

> ...the integration of 2 separate sensors in 2 dimensions which are perpendicular at least to the imaging sensor plane acquires information for motion derivation in 3-dimensions using 1-dimensional relative measurement vectors.
>
> Office Action, page 5.

After reviewing the foregoing statement, Applicants respectfully note that the Examiner's response is vague and unclear. As best understood, the Examiner appears to be asserting that the Hossack reference allegedly discloses two sensors that acquire two-dimensional data in directions perpendicular to an imaging sensor "plane" which, by definition, is also two-dimensional. As such, Applicants are unable to ascertain how this particular

arrangement of sensors is capable of acquiring *one-dimensional* "relative measurement vectors," as alleged by the Examiner. Additionally, it should be noted that the Examiner failed to provide any citations to the Hossack reference to support the foregoing assertion, as is required under 37 C.F.R. §1.104(c)(2) (noting that when a reference is complex, the particular part relied on must be designated as nearly as practicable).

Moreover, Applicants do not believe the Leotta reference, which was cited in combination with the Hossack reference in the rejection of independent claims 1, 14, 27, and 38, obviates the above-discussed deficiencies, nor has the Examiner indicated that the Leotta reference was relied upon in this regard. Instead, it appears that the Examiner relied upon the Leotta reference solely for teaching the calibration and validation of acquired motion data.[1] *See id.* at page 3. However, this reliance alone fails to remedy the deficiencies of the Hossack reference.

2. *The cited references fail to teach or suggest first, second, and third axes that are perpendicular to one another.*

As discussed in the Previous Response, even assuming, *arguendo*, that the two-dimensional data acquired via transducer arrays 18, 20, and 22 could somehow be interpreted as being "one-dimensional motion data," Applicants submit that the Hossack reference still fails to disclose or suggest that one-dimensional motion data is acquired along first, second, and third axes, each of which are perpendicular with respect to one another. For example, referring to Fig. 1 of the present Application, perpendicular first, second, and third axes could refer to an x-axis, y-axis, and z-axis of a Cartesian coordinate system. *See* Application, Fig. 1.

[1] Applicants note that the features of Leotta relied upon by the Examiner, i.e., validation of motion data, are not even recited by the independent claims. Rather, these features are recited by dependent claims 3, 16, 28, and 41.

Based upon the Examiner's interpretation of the Hossack reference, as discussed above, the three axes along which "one-dimensional motion data" is allegedly acquired by the transducer arrays 18, 20, and 22 would correspond to an azimuthal axis, a first tracking axis, and a second tracking axis, as shown in Fig. 4 of the Hossack reference. For instance, the Hossack reference states that the first transducer array 18 is configured to acquire a first set of data along an azimuthal axis (e.g., the asserted first axis), labeled as "A," that the second transducer array 20 is configured to acquire a second set of data along a first tracking axis (e.g., the asserted second axis), labeled "T1," and that the third transducer array 22 is configured to acquire a third set of data along a second tracking axis (e.g., asserted third axis), labeled "T2." *See id.* at col. 5, lines 48-56; Fig. 4. However, as *clearly* shown in the Hossack reference, while both of the tracking axes T1 and T2 are "<u>substantially perpendicular</u> to the azimuthal axis A," they are *clearly* not perpendicular to one another. *Id.* at col. 5, lines 54-56. (Emphasis added). Indeed, Fig. 4 of the Hossack reference clearly illustrates the transducer arrays 18, 20, and 22 and their respective axes, such that the arrangement of the three axes, A, T1, and T2, results in T1 and T2 each being perpendicular to A, but being <u>parallel</u> to each other. Accordingly, Applicants stress that the Hossack reference appears to disclose, at best, two <u>parallel</u> tracking axes (T1 and T2) that are perpendicular to an azimuthal axis (A). The Hossack reference does not, however, illustrate that <u>each of the first (A), second (T1), and third (T2) axes along which motion data is acquired are perpendicular to each other</u>, as recited by independent claims 1, 14, 27, and 38.

In the present Office Action, the Examiner responded to Applicants' previous arguments by further directing Applicants' attention to Figs. 27a-27e of the Hossack reference.[2] Specifically, the Examiner stated that "Hossack et al also discloses the use of sensor-based acquisition data from 2 sensors which can be placed perpendicular to each other (27a-j), along with acquisition image data." Office Action, page 3. Referring to

[2] The Examiner actually cited to Figs. 27a-27j. However, Applicants note that the Hossack reference does not contain Figs. 27f-27j.

Figs. 27a-27e of the Hossack reference, Applicants note that these figures appear to show alternate configurations and arrangements of the transducer arrays 18, 20, and 22 shown in Fig. 4. However, after careful review, it does not appear that any of the alternate configurations shown in Figs. 27a-27e provide for the acquisition of motion data along first, second, and third axes that are each perpendicular to one another. For instance, Fig. 27a shows two tracking arrays 114 which lie along axes that are coplanar with each other, and thus not perpendicular. Fig. 27b shows only a single tracking array 114, and thus fails to account for the recited third axis. Finally, Figs. 27c-27e each show a plurality of tracking arrays 114 that are parallel to each other, and thus not perpendicular. Accordingly, none of the additional embodiments shown in the Hossack reference and noted by the Examiner appear to disclose first, second, and third axes that are each perpendicular to one another, as recited by independent claims 1, 14, 27, and 38.

Additionally, as discussed above, the Leotta reference, which was cited in combination with the Hossack reference in the rejection of independent claims 1, 14, 27, and 38, was relied upon solely for teaching the calibration and validation of acquired motion data and, therefore, fails to obviate the above-discussed deficiencies.

3. The cited references fail to teach or suggest the derivation of at least one motion vector for each of the first, second, and third sets of motion data.

As further discussed in the Previous Response, the Hossack reference also fails to teach deriving at least one concurrent motion vector for *each* of the first, second, and third sets of motion data. *See, generally,* Previous Response, pages 22-23. Keeping the above part-to-part relationships in mind and assuming, for the sake of argument, that the Hossack reference could be construed as somehow disclosing the acquisition of one-dimensional motion data, Applicants note that to the extent the Hossack reference appears to disclose deriving motion vectors for the data acquired along the T1 and T2 tracking axes, the reference does not appear to disclose that at least one motion vector is *also* derived for the data acquired along the azimuthal axis (A).

For example, referring to Fig. 1 of the Hossack reference, three storage arrays 30, 32, and 34 are illustrated as storing a first, a second, and a third set of data acquired by the transducer arrays 18, 20, and 22, respectively. *See* Hossack, Fig. 1. However, it appears that <u>only</u> the second (T1 data) and third (T2 data) sets of data are provided to a vector calculator block 42. *See id.* According to the Hossack reference, it is this vector calculator block 42 which calculates motion vectors and outputs them to a computer 36 for use in the three dimensional image reconstruction of the acquired data. *See id.* at col. 5, lines 20-23. However, with regard to the first set of data in storage array 30 (e.g., acquired along azimuthal axis "A"), Fig. 1 of the Hossack reference clearly shows that this first set of data is provided *directly* to the <u>reconstruction</u> computer 36 <u>without</u> having any corresponding motion vectors generated or derived. *See id.* at Fig. 1. In other words, to the extent that the Hossack reference contemplates deriving motion vectors, it appears that motion vectors are derived <u>only</u> for the data acquired along the tracking axes T1 and T2. As such, it is believed that the Hossack reference <u>does not</u> disclose that a motion vector is derived for <u>each</u> of the data sets (e.g., data acquired along the T1, T2, and A axes), as recited by independent claims 1, 14, 27, and 38.

In response to the foregoing points, the Examiner stated in the present Office Action that "the image data (plane) in the Hossack reference passes through the azmithual [*sic*] axis and thereby forms the 'A' axis. Additionally, through the use of intermediate frame data, in plane data is normalized and out-of-plane data is aggregated into vectors." Office Action, page 5. As best understood, the Examiner appears to be asserting that at least a portion of the data acquired along the azimuthal axis A is somehow used to derive motion vectors. In support of this assertion, the Examiner cited to the following passages and figures of the Hossack reference:

FIGS. 7-10 show four sets of images. Each set includes an image 66A, B, C, D from the image data array 18 and a corresponding image 68A, B, C, D from one of the tracking arrays 20, 22. In this case the target is a sphere, and the images 66, 68 intersect such that the sphere appears in both images 66, 68. As shown in images 66A, B, C, and D, various cross sections of the sphere are displayed as the transducer 16 rotates about the azimuthal axis. The cross sections shown in images 66A and 66D show smaller diameter disks taken near an edge of the sphere, and the images 66B and 66C show larger diameter disks taken near the center of the sphere. Thus, the disks shown on the images 66A, B, C and D differ in diameter, in accordance with the moving plane of the image (see FIG. 6). In contrast, the images 68A, B, C, and D all show disks of the same size. Because the plane of the images 66A, B, C, and D remains the same, as discussed above in conjunction with FIG. 6, the disk that is displayed in these images remains constant in size but moves across the image plane. The location of the disk as it moves from one image to the next provides a measure of a component of motion of the transducer 16 in the image plane of the images 68A, B, C, D.

If the image plane of the transducer arrays 20, 22 are not perpendicular to the surface of the image data array 18 (for example because the tracking arrays 20, 22 are pointed inwardly as shown in FIG. 3), it may be preferred to use a cosine θ correction factor to take account of the difference between image range and physical depth perpendicular to the image data array 18.

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Any suitable correlation technique can be used, including cross correlation and the sum of absolute differences method as discussed in Bohs and Trahey "A Novel Method For Angle Independent Ultrasonic Imaging Of Blood Flow And Tissue Motion" (IEEE Trans. on Biomed. Eng., 38, 3, pp. 280-286, March, 1991). Cross correlation is the well-known mathematical operation which uses sequentially obtained sums of multiplication operations for various translations of data in a search for the

> translation for which the two sets of data are best matched. The sum of absolute differences method is a computationally simpler correlation technique, but it achieves a similar net effect. The sets of data are translated by varying amounts. For each translation respective data values in each of the sets are subtracted and the sum of the absolute differences is calculated. If a particular translation gives a sum of absolute differences that is close to zero, then it is probable that the sets of data have been aligned by the associated translation. This translation required to achieve an alignment is an indication of the motion between the two respective frames at the sides of the image closest to the respective tracking array. As explained below, the motion at other parts of the image can be evaluated using the detected motion at both tracking arrays and linear interpolation techniques along the azimuth of the image data array 18.
>
> Hossack, col. 7, lines 15-45; col. 8, lines 30-55; Figs. 7-10.

After carefully reviewing the cited passages, Applicants are unable to locate any language teaching or suggesting that motion vectors are derived for the data acquired along the azimuthal axis (A). For instance, regarding first the passages cited from column 7 of the Hossack reference, this passage describes, in conjunction with Figs. 7-10, the various images acquired via the tracking arrays 20 and 22 (e.g., along the T1 and T2 axes). The cited passages state that the series of images acquired along the tracking axes T1 and T2 may provide "a measure of a component of motion" in the plane of the images 68A-68D (e.g., the data acquired along the tracking axes T1 and T2). Additionally, the passages cited from column 9 of the Hossack reference appear to describe techniques for using the data acquired along the tracking axes T1 and T2 to apply some form of linear interpolation to the data set acquired along the azimuthal axis (A). However, contrary to the Examiner's assertions, there does not appear to be any mention in the above-cited passages of the Hossack reference regarding the derivation of <u>motion vectors</u> for the data acquired along the azimuthal axis (A). Accordingly, it is believed that the Hossack

reference fails to disclose the derivation of motion vectors for *each* of first, second, and third data sets, as recited by claims 1, 14, 27, and 38.

Further, as discussed above, the Leotta reference, which was cited in combination with the Hossack reference in the rejection of independent claims 1, 14, 27, and 38, was relied upon solely for teaching the calibration and validation of acquired motion data and, therefore, fails to obviate the above-discussed deficiencies.

4. *Request withdrawal of the rejection of Independent Claims 1, 14, 27, and 38 based on the Hossack and Leotta references.*

For at least the reasons discussed above, Applicants submit that the Hossack and Leotta references, taken alone or in combination, fail to disclose each and every feature recited by independent claims 1, 14, 27, and 38. Accordingly, no *prima facie* case of obviousness is believed to exist with regard to these independent claims based upon the Hossack and Leotta references. As such, Applicants respectfully request withdrawal of the rejection under 35 U.S.C. §103(a) of independent claims 1, 14, 27, and 38, as well as those claims depending therefrom.

The Hossack and Leotta references fail to teach or suggest features recited by Dependent Claims 3, 16, 28, and 41.

Claims 3, 16, 28, and 41 depend from claims 1, 14, 27, and 38, respectively, and recite validating the one-dimensional motion data "using one or more respective sets of validation motion data." For instance, with reference to the specification, validation motion data is described as "motion data acquired for the axis using data-based techniques, such as from pre-acquisition image data or acquisition image data." Application, page 15, lines 7-8. The validation data may be acquired using a validation sensor (e.g., sensor 100, Fig. 5) which may measure either the same or a different parameter from the data set being validated. *See id.* at lines 8-11. In other words, the validation motion data, as recited in the presently pending claims, refers to a separate set

of motion data acquired for the purposes of "validating," or establishing a metric of reliability for the acquired one-dimensional motion data. *See id.* at lines 17-18.

In the present Office Action, the Examiner admitted that the Hossack reference fails to disclose the validation of motion data, but stated that the Leotta reference addresses these deficiencies. Specifically, the Examiner, citing to pages 1415-1416, asserted that the Leotta reference discloses "the use of calibration/validation data with an ultrasound/motion determination system. The calibration and validation data allows for the sets of data to be efficiently and actively validated during acquisition and during/pre reconstruction." Office Action, page 3. After reviewing the cited portions of the Leotta reference, Applicants respectfully disagree.

As best understood, the Leotta reference generally relates to an ultrasound imaging system that utilizes magnetic sensors and one or more magnetic transmitters, whereby the magnetic sensors undergo relative rotations of 45 degrees along one or more axes during data acquisition, and that that the resulting data is averaged. *See* Leotta, page 1416; Table 1. The Leotta reference also discusses a calibration procedure, which may include obtaining measurements from the magnetic sensors at 32 points about a pivot point to determine RMS uncertainty values associated with the pivot point. *See id.* As noted by the Leotta reference, the calibration steps result in improved accuracy regarding the distance-relationship between the magnetic receivers (e.g., sensors) and an ultrasound imaging plane. *See id.* at page 1415. In other words, the disclosed calibration steps are performed *prior* to data acquisition in order to improve the accuracy of the acquired data.

In the present rejection, the Examiner appears to equate to the recited step of "validation" with the described "calibration" technique. Applicants respectfully disagree with this characterization of the term "validation." As the Examiner can appreciate, pending claims must be given an interpretation that is reasonable and consistent with the *specification*. *See In re Prater*, 415 F.2d 1393, 1404-05, 162 U.S.P.Q. 541, 550-51

(C.C.P.A. 1969) (emphasis added); *see also In re Morris,* 127 F.3d 1048, 1054-55, 44 U.S.P.Q.2d 1023, 1027-28 (Fed. Cir. 1997); *see also* M.P.E.P. §§ 608.01(o) and 2111. Moreover, interpretation of the claims must also be consistent with the interpretation that *one of ordinary skill in the art* would reach. *See In re Cortright*, 165 F.3d 1353, 1359, 49 U.S.P.Q.2d 1464, 1468 (Fed. Cir. 1999); M.P.E.P. § 2111. As noted above, the recited "validation motion data" refers to a separate set of motion data acquired for the purposes of "validating," or establishing a metric of reliability for the acquired one-dimensional motion data. *See* Application, page 15, lines 17-18. In contrast, the calibration steps discussed in the Leotta reference appears to merely place the imaging system into an operational state that yields more accurate results. In other words, there does not appear to be any suggestion in the Leotta reference to suggest that calibration data (e.g., Table 1) is used to validate any acquired data, as recited by claims 3, 16, 28, and 41.

Accordingly, while claims 3, 16, 28, and 41 are believed to be allowable at least by virtue of dependency from their respective allowable parent claims, Applicants respectfully submit that claims 3, 16, 28, and 41 are also allowable for the subject matter additionally recited.

The Hossack, Leotta, and Friemel references fail to teach or suggest features recited by Dependent Claims 44, 46, and 48.

Claims 44, 46, and 48 depend from claims 1 (by way of intervening claim 43), 14 (by way of intervening claim 15), and 27 (by way of intervening claim 47), respectively, and recite one or more sensors being affixed to a subject of interest (e.g., a patient). In the present Office Action, the Examiner admitted that the Hossack reference and Leotta references fail to disclose sensors affixed to a subject of interest, but asserted that the Friemel reference addresses this deficiency. After reviewing the Friemel reference, Applicants respectfully disagree.

In the rejection, the Examiner characterized an ultrasound transducer 16 (shown in Fig. 1 of Friemel) as being a "stationary" sensor and, therefore, affixed to a subject of interest. Office Action, page 4. However, the Friemel reference clearly states that, during imaging, "[a] sonographer 36 moves the transducer 16 along the patient's skin surface 38 in a direction parallel with the ultrasonic scan plane 40." Friemel, col. 5, lines 50-54. (Emphasis added). Indeed, there does not appear to be any language in the Friemel reference to suggest that the transducer 16 remains stationary during data acquisition, as suggested by the Examiner. Further, because the transducer 16 is clearly described as being non-stationary, it would be wholly unreasonable to characterize the transducer as being "affixed," especially in view of the plain and ordinary meaning of the term (e.g., to attach physically, add, append, impress, or fasten). *See* Definition of "affix," Merriam-Webster Dictionary, available at http://www.merriam-webster.com/dictionary/affix.

Accordingly, while claims 44, 46, and 48 are believed to be allowable at least by virtue of dependency from their respective allowable parent claims, Applicants respectfully submit that claims 44, 46, and 48 are also allowable for the subject matter additionally recited.

The Hossack and Leotta references fail to teach or suggest features recited by New Independent Claim 50.

By this Response, Applicants have added independent claim 50, which recites, *inter alia*, "a sensor-based motion determination system configured to acquire one-dimensional motion data from one or more sensors, wherein at least one of the one or more sensors comprises a pad configured to affix the sensor to a body surface of the patient" and "wherein the one or more sensors are configured to remain generally stationary with respect to the position of the patient during the acquisition of the first, second, and third sets of one dimensional motion data." (Emphasis added). Applicants respectfully submit that these recited features of claim 50 are absent from the Hossack, Leotta, and Friemel references.

First, the cited references fail to teach or suggest a sensor comprising a pad configured to affix the sensor to a body surface of the patient. For instance, as discussed above with regard to the rejection of claims 44, 46, and 48, the Examiner acknowledged that the Hossack and Leotta references fail to disclose sensors that are configured to be affixed to a subject of interest. Further, to the extent that the Friemel reference discloses an ultrasound transducer 16 (alleged by the Examiner to be "stationary" and "affixed" sensor), there is nothing in the reference to suggest that the ultrasound transducer 16 is stationary or affixed to a subject of interest, much less that it comprises a pad for affixing the sensor to a body surface of the subject of interest.

Second, the cited references also fail to teach or suggest one or more sensors that remain generally stationary with respect to the position of the patient during the acquisition of the first, second, and third sets of one-dimensional motion data. For instance, Applicants note that both of the Hossack and Friemel references disclose an ultrasound transducer device containing one or more transducer elements, which the Examiner appears to have correlated to the recited "one or more sensors." Assuming such a characterization is reasonable, Applicants note that each of the Hossack and Friemel references disclose that the transducer device is <u>moved</u> by an operator (e.g., a sonographer) during the acquisition of ultrasound data. For instance, the Hossack reference clearly states that "[i]n one mode of operation, the transducer 16 is <u>rotated through a sweep under the direct manual control of an operator</u>." Hossack, col. 5, lines 34-36. (Emphasis added). The Friemel reference similarly states that, during imaging, "[a] sonographer 36 <u>moves the transducer 16 along the patient's skin surface</u> 38 in a direction parallel with the ultrasonic scan plane 40." Friemel, col. 5, lines 50-54. (Emphasis added).

Indeed, each of the Hossack and Friemel references discloses a technique for acquiring ultrasound data in which one or more transducer elements are *moved* along a patient's skin during data acquisition. Further, as mentioned above, the Leotta reference appears to disclose an ultrasound imaging system that utilizes magnetic sensors and one or more magnetic transmitters, whereby the magnetic sensors are configured to *rotate* along various angular positions about a subject during image acquisition. In other words, none of the cited references appear to disclose sensors that remain generally stationary with respect to the position of the patient during the acquisition of the first, second, and third sets of one-dimensional motion data, as recited by independent claim 50. Consequently, Applicants submit that the newly added independent claim 50 is allowable over the cited references, taken either alone or in combination.

Conclusion

In view of the remarks and amendments set forth above, Applicants respectfully request allowance of the pending claims. If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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